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Faraone, S.V.; Sergeant, J.A.; Gillberg, C.; Biederman, J

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The worldwide prevalence of ADHD: is it an American condition?

STEPHEN V. FARAONE[1,2,3], JOSEPH SERGEANT[4], CHRISTOPHER GILLBERG[5,6], JOSEPH BIEDERMAN[1,2,3]

[1]Department of Psychiatry, Harvard Medical School, Massachusetts General Hospital, 55 Fruit Street, Boston, MA 02114-3139, USA; [2]Harvard Institute of Psychiatric Epidemiology and Genetics, Boston, MA, USA; [3]Johnson and Johnson Center for Pediatric Psychopathology at the Massachusetts General Hospital, Boston, MA, USA; [4]Vrije Universiteit, Amsterdam, The Netherlands; [5]Göteborg University, Göteborg, Sweden; [6]University of London, London, UK

Attention-deficit/hyperactivity disorder (ADHD) is a behavioral disorder that affects up to 1 in 20 children in the USA. The predominance of American research into this disorder over the past 40 years has led to the impression that ADHD is largely an American disorder and is much less prevalent elsewhere. This impression was reinforced by the perception that ADHD may stem from social and cultural factors that are most common in American society. However, another school of thought suggested that ADHD is a behavioral disorder common to children of many different races and societies worldwide, but that is not recognized by the medical community, perhaps due to confusion regarding its diagnosis and/or misconceptions regarding its adverse impact on children, their families, and society as a whole. In this article we present the available data, with a view to determining the worldwide prevalence of ADHD. A total of 50 studies were identified from a MEDLINE search for the terms ADHD, ADD, HKD, or attention-deficit/hyperactivity disorder and prevalence combined, for the years 1982 to 2001. 20 were studies in US populations and 30 were in non-US populations. Analysis of these studies suggests that the prevalence of ADHD is at least as high in many non-US children as in US children, with the highest prevalence rates being seen when using DSM-IV diagnoses. Recognition that ADHD is not purely an American disorder and that the prevalence of this behavioral disorder in many countries is in the same range as that in the USA will have important implications for the psychiatric care of children.

Key words: Attention deficit disorder (ADD), attention-deficit/hyperactivity disorder (ADHD), hyperkinetic disorder (HKD), prevalence

Attention-deficit/hyperactivity disorder (ADHD) is a behavioral disorder believed to affect up to 1 in 20 children in the USA (1). It is characterized by symptoms of inattention and/or impulsivity and hyperactivity which can significantly impact on many aspects of behavior and performance, both at school and at home. In approximately 80% of children with ADHD, symptoms persist into adolescence and may even continue into adulthood. The effects of ADHD significantly impact on the individual throughout childhood and well into adult life, especially if not managed optimally; people with ADHD tend to have a lower occupational status, poor social relationships, and are more likely to commit motoring offences and develop substance abuse (2). Parents and siblings also suffer as a result of the behavioral problems associated with ADHD; increased levels of stress are common as are depression and marital discord (3,4).

ADHD has been extensively studied in the USA over the past 40 years and this has led to our detailed understanding of the behavioral characteristics of the condition as it is now defined by the American Psychiatric Association (APA)'s DSM. However, this predominance of American research in this field and apparent differences in the prevalence of ADHD, or hyperkinesis, as defined by the World Health Organization (WHO) ICD, has also led to the impression that this is largely an American disorder and is much less prevalent elsewhere. For example, as pointed out by Taylor and Sandberg (5), data from studies in the late 1970s give a 20-fold greater prevalence of childhood hyperactivity in North America compared with England.

Taylor (5,6) addressed this issue in a comparison of factor analyses for seven different studies of children from the USA (3), UK, Australia, New Zealand, and Canada. He found that in all studies, descriptions of being restless and distractable formed a coherent factor corresponding to hyperactivity, which was distinct from antisocial behaviors such as defiance and aggressiveness. When the scores on this hyperactivity factor were compared from the different studies, they were found to be similar across the seven studies. Taylor thus suggested that the prevalence of such hyperactive behavior is probably similar across these different countries and that the apparent 20-fold difference in the prevalence of hyperactivity reflects differences in the definition of the condition rather than real differences in behavior between British and American children. For example, children with hyperactive behavior may be more likely to be diagnosed as having conduct disorder in the UK and ADHD in the USA.

This lack of a true difference in behavior between American and British children was further confirmed in a Scottish study of children referred to a Scottish Child Guidance Service and a group of control children (matched for age, sex, socio-economic status, and ability) (7). All children were scored for hyperactivity using the Conners' 1969 Teacher Rating Scale, as used in the USA. 4.5% of the controls were scored as hyperactive. This figure is similar to the prevalence of hyperactivity in the USA of 3-5% from studies using a similar definition (e.g. 8,9). Of the referred children, 42.7% were scored as hyperactive; this is comparable to the percentage (30-40%) of chil-

dren referred to child guidance clinics in the USA who are diagnosed as hyperactive (10). These data thus also suggest that apparent differences in the prevalence of ADHD reflect differences in diagnostic practice rather than true differences in behavior.

However, the question still remains, whether ADHD is largely an American disorder, perhaps stemming from social and cultural factors which are more common in American society. Alternatively, is this behavioral disorder common to children worldwide, or to a large number of races and societies, but not recognized by the medical community, perhaps due to confusion regarding its diagnosis and/or misconceptions regarding its adverse impact on children and their families and society as a whole, or persistent concerns regarding its treatment with stimulant drugs? This article reviews the available data regarding the prevalence of ADHD in different countries and cultures with a view to answering this question.

Before presenting these data, it is necessary to consider the factors which affect the prevalence figures arrived at in such epidemiological studies. The most obvious of these are probably the diagnostic criteria for ADHD, which have been evolving over the last 20-30 years since the terms 'attention deficit' and 'hyperactivity' were introduced. Terms such as 'minimal brain dysfunction' and 'organic brain dysfunction' have also been used to describe this behavioral disorder but have now largely been superseded. The terms 'hyperkinetic disorder' (HKD) and 'deficits in attention, motor control and perception' (DAMP) are still in use in the UK and a few other European countries (HKD) and Scandinavia (DAMP). (HKD defines a subset of patients with a particularly severe form of ADHD.) Other factors which affect prevalence rates include characteristics of the sample population, methods of diagnosis, and how rigorously diagnostic criteria are applied. Each of these factors will now be considered in detail.

Over the years, the diagnostic criteria for the condition now known as ADHD have evolved as research has furthered our understanding of the distinctive characteristics of the disorder. These developments can be mapped in the series of definitions published by the APA in the updates to their DSM and by the WHO revisions of the ICD. 'Attention deficit disorder with hyperactivity' (ADD-H) was introduced as a defined disorder in the DSM-III in 1980 (11) and this was updated in 1987 with the revised edition (DSM-III-R) (12), in which the disorder was redefined as 'attention deficit hyperactivity disorder' (ADHD). The disorder was redefined again in 1994 in the fourth edition of the DSM (DSM-IV) (1) and named 'attention-deficit/hyperactivity disorder'. The WHO definitions of hyperkinesis have also been revised from the ICD-9 definition published in 1978 to their more recent definition in ICD-10 published in 1992. While the WHO ICD-10 definition is still used in some countries, mainly in Europe, there is now a general move to using the DSM-IV definition of ADHD, which should make comparison of data between studies much easier.

This move towards a consensus for the definition of ADHD should facilitate the development of a clear picture of the worldwide epidemiology of the condition. However, it is still complicated by differences in how rigorously all the elements of the DSM-IV definition are applied. For example, some researchers omit the requirement for symptoms to be present in at least two settings (e.g. 13), while others omit the requirement for functional impairment resulting from the symptoms (e.g. 14,15). Other factors which affect the diagnosis of ADHD in different studies are: the informants used to assess symptoms, e.g. whether parents and/or teachers and/or subjects; and whether the diagnosis is based on scores on behavior checklists (e.g. 16-18), or from direct interviews (e.g. 15) or both (e.g. 19,20).

Further variations in the apparent prevalence rate arise from differences in the population surveyed. Epidemiological studies of ADHD generally either use representative community samples or school samples. An analysis of epidemiological studies in the USA found that community samples gave higher prevalence rates than school samples (mean prevalence: 10.3% for community samples vs. 6.9% for school samples) (21). It is generally agreed that the prevalence of ADHD is significantly greater in boys than girls, especially in children. Thus the ratio of males:females in the sample population can affect the apparent prevalence and may need to be taken into account. Similarly, the prevalence of ADHD is known to vary with age. For example, three studies have shown decreases in prevalence with increasing age over the age range 10-20 years (22), 8-15 years (23), and 6-14 years (24). Thus, even within studies of children, the age range of the sample is likely to affect the apparent prevalence.

These confounding factors make it difficult to compare the prevalence data for ADHD from one study and from one country to another. It is necessary to take these factors into account when comparing data from different studies.

METHODS

A MEDLINE search for the terms ADHD, ADD, HKD or attention-deficit/hyperactivity disorder and prevalence, combined with screening the reference lists of the obtained studies, identified papers reporting on the prevalence of ADHD. Papers were then checked to ascertain the population studied and the diagnostic criteria used. Only studies sampling from the general population or a well specified non-referred population (e.g., schools) were included in the next stage. This eliminated three studies that reported the prevalence of ADHD in clinic samples. The remaining papers were analyzed according to the diagnostic criteria employed.

In 50 papers, diagnoses of ADHD or ADD-H were based on DSM-III, DSM-III-R or DSM-IV criteria and

these were included in the further analysis. (Two papers employed DSM-III criteria but only presented data for ADD without hyperactivity and were thus excluded.) Of these 50 papers, 20 were studies of US populations and 30 were of non-US populations. A further four papers used ICD-9 or ICD-10 diagnostic criteria (one study each from the following countries: Hong Kong, Germany, France, and India), and another five used other definitions of hyperactivity (one study from each of the following countries: USA, UK, Sweden, Canada, and China). These nine papers were not included in the more detailed analysis. However, the populations studied in these papers were all represented in the 50 papers which were included in the further analysis, with the exception of France. Of note, no studies of ADHD in African populations were identified (except one unpublished study of children in Johannesburg described in Yao et al [25]), nor were there any studies in Eastern Europe. The selected studies cover a period from 1982 to 2001.

RESULTS

DSM-III studies

Thirteen studies were identified which included an assessment of the prevalence of DSM-III ADD-H in children and adolescents. These studies spanned the period from 1982 to 1998 and included four studies of US populations and nine studies of non-US children. Two of the more recent studies (16,26) also included assessments employing the more recent DSM-III-R and DSM-IV diagnostic criteria and are thus valuable for determining the effect of the diagnostic criteria on apparent prevalence, as will be discussed later.

All four studies of US populations (Table 1) involved children with a mean age of 9-11 years and investigated children within a similar age range. The prevalence rates for three of the studies lie within the range 9.1-12%. The one study involving less than 100 children reported a higher prevalence (18%) when teacher reports were used to determine the diagnosis, but gave a lower value (8%) when parent ratings were used (26). Of note, the study of King and Young (27) only involved boys; the prevalence rate of 12% at the upper end of the range for these studies is consistent with the accepted observation that ADD-H/ADHD is more prevalent in males than females. Shekim et al (28) reported the prevalence of ADD-H, as determined from interviews with subjects, interviews with parents, and the rate of agreement between the two methods. When the assessment was based on the subject's reports of symptoms, a prevalence rate of 4% was reported, and when the diagnosis was dependent on both parent and subject reporting, this yielded a prevalence of only 2%. This suggests that children of this age are poor informants of ADD-H/ADHD symptoms and agreement between parents and subjects is poor, as is well recognized (20,29,30).

Of the nine studies in non-US populations, two were in adolescents (aged 15 years) (31,32) and reported prevalence rates of less than 1%. The remaining seven studies (Table 2) involved children aged 4-16 years and with mean ages of 7-11 years, and thus constitute a homogeneous age range comparable to that of the US studies. These studies reported prevalence rates in the range of 5.8-11.2%, except for the study of Taylor et al (33), which involved only boys and reported a higher prevalence of 16.6%, as might be expected for a totally male sample. The study of Leung et al (34) also involved a totally male population; thus the 6.1% prevalence of hyperactivity in this study may indicate a lower overall prevalence in Hong Kong compared to other countries. The authors suggested that both biological and cultural differences may account for the prevalence rates of hyperactivity in Chinese children. Interestingly, Taylor and Sandberg's study (5) also reported on the prevalence of hyperkinesis for their population of school boys aged 6-8 years. This value, 1.7%, is approximately one-tenth that of the reported prevalence of ADD-H in the same study. This difference in prevalence between hyperkinesis and ADD-H further supports Taylor's suggestion than the apparent difference in prevalence of ADHD/hyperactivity between US and British children stems from the difference in definition of the disorder rather than true behavioral differences between the two countries.

Table 1 Studies assessing prevalence of ADHD symptoms as defined by DSM-III in US children and adolescents

Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
Bauermeister *et al* (57)	Children aged 4–16 in Puerto Rico	Interview (parent subject) Report (teacher)	Parent, teacher, subject	11	6–16	Not specified	614	9.1
King *et al* (27)	School	Rating scale	Teacher, subject	9.1	7–11	100	219	12
Newcorn *et al* (26)	School	Rating scale	Parent, teacher	9.5	–	44	72	18 (teacher) 8 (parent)
Shekim *et al* (28)	School	Interview	Parent, subject	9	–	Not specified	114	12 (parent) 4 (subject) 2 (parent and subject)

Table 2 Studies assessing prevalence of ADHD symptoms as defined by DSM-III in non-US children and adolescents

Country	Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
Canada	Szatmari *et al* (58)	Representative sample of all children born between 1966 and 1979 living in Ontario	Rating scale (parent, teacher, subject*)	Teacher, parent, subject	10	4–16	50	2722	5.8
China	Shen *et al* (59)	School	Rating scale (teacher) Interview (subject)	Teacher, subject	10.1	7–14	Not specified	2770	5.8
Germany	Baumgaertel *et al* (16)	School	Rating scale	Teacher	8.5	5–12	Not specified	1077	6.4
Hong Kong	Leung *et al* (34)	School	Rating scale (teacher) Interview (parent, teacher)	Teacher, parent	–	7–8	100	3069	6.1
India	Bhatia *et al* (60)	Hospital outpatient clinic	Rating scale (parent) Interview (parent, subject)	Teacher, subject	7.5	3–12	61	1000	11.2 (3–4 years: 5.2 11–12 years: 29.2)
The Netherlands	Verhulst *et al* (61)	Representative sample of children aged 8 or 11 years living in The Netherlands	Rating scale (teacher, parent) Interview (subject)	Teacher, parent, subject	–	8 & 11	50	116	9.5
UK	Taylor *et al* (33)	School	Rating scale	Teacher, parent	7	6–8	100	3215	16.6

* Rating scale only administered to subjects aged 12–16 years.

DSM-III-R studies

A total of 22 studies were identified which had assessed the prevalence of ADHD using DSM-III-R criteria. These included 10 studies of US populations and 12 studies of non-US populations and were performed over a 12-year period from 1989 to 2001. As with the DSM-III studies, several have also included diagnosis using DSM-III or DSM-IV criteria and hence allow an estimation of the impact of diagnostic criteria on the apparent prevalence of ADHD/ADD-H.

The details of the 10 US studies are given in Table 3, with the exception of one study, which assessed prevalence in late adolescence and in young adults (age 16-22 years) (35). Five of the remaining studies involved children aged 5-14 years and with a mean age between 8 and 10 years (17,26,36-38). A sixth study (22) presented prevalence data for subjects aged 10-20 years, but reported prevalence figures for three age ranges within the population; the lowest age range (10-13 years) fell within that of the other five studies and thus was included in the analysis. Data from these six studies gave prevalence rates in the range 7.1-12.8%, with the outlier values of 26% based on teacher assessments in the Newcorn et al study (26), and 2.8% in the study of August et al (37). The Newcorn et al study involved less than 100 subjects from an inner city school and thus may not be representative of the general population. Also, the prevalence rate based on parent assessments (11%) in this study does fall within the range for the other studies. The study of August et al (37) used an initial screen for disruptive behaviors that employed a rather conservative threshold, so as to minimize false positive identifications, followed by more detailed screening to diagnose the particular disorders. This use of a conservative initial screening method may have led to an underestimation of prevalence.

A seventh study (39) involved a slightly older population than the other studies (aged 9-17 years, mean age 13 years) and reported a somewhat lower prevalence rate of 4.5% (based on parent reports). This is in keeping with other data (e.g. 22) which indicate a decrease in prevalence with increasing age into adolescence and adulthood. Simonoff et al (40) also reported a low prevalence rate (2.4%) for an older population (aged 8-16 years); this was a population of Caucasian twin pairs and thus may not be representative of the general population. Finally, Lewinsohn et al (41) studied an adolescent population and reported a particularly low prevalence rate of 0.41%. However, this value was based on subject self reports of symptoms, and adolescents are known to be poor reporters of their own symptoms (42).

Twelve studies of non-US populations were identified which employed DSM-III-R diagnostic criteria. For one of these studies (43) the same data were reported in terms of DSM-IV criteria in a separate paper (44). The earlier paper was therefore excluded from this analysis and the later paper was reviewed with the other papers using DSM-IV criteria. The remaining 11 studies are summarized in Table 4. Four of these studies (23,45-47) involved adolescents (for Gomez-Beneyto et al [23] a 15-year age group) and report low prevalence rates (1.8-3.9%) as would be expected for this older population. The remaining eight studies (including the two younger age groups included in study of Gomez-Beneyto et al [23]) involved children aged 5-15 years and with a mean age of 6.5-11

Table 3 Studies assessing prevalence of ADHD symptoms as defined by DSM-III-R in US children and adolescents

Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
August and Garfinkel (36)	School	Rating scale	Teacher	9.79	5.33–14.25	Not specified	1038	8.6
August *et al* (37)	School	Interview (subject) Rating scale (subject, teacher, parent)	Subject, teacher, parent	8	6–10	Not specified	7231	2.8
Cohen *et al* (22)	Children originally sampled in 1975 when aged 1–10 years and living in an upstate New York county, plus sample of children aged 9–12 living in urban low income areas of the original county in 1983	Interview	Parent, subject	11.5 15 18.5	10–13 14–16 17–20	52 48 50	541 508 446	12.8 8.9 6.0
Lewinsohn *et al* (41)	School	Interview	Subject	-	16–20 (grade 9–12)	Not specified	1710	0.41
Newcorn *et al* (26)	School	Rating scale	Parent, teacher	9.5	–	44	72	26 (teacher) 11 (parent)
Pelham *et al* (38)	School	Rating scale	Teacher	9.5	5–14	100	931	7.1
Simonoff *et al* (40)	Population white twins	Interview (subject, parent) Rating scale (subject, parent, teacher)	Subject, parent, teacher	-	8–16	46.3	2762 pairs	2.4
Shaffer *et al* (39)	Sample of children aged 9–17 (details not given)	Interview	Parent, subject	13	9–17	Not specified	1285	4.5 (parent) 2.2 (subject)
Wolraich *et al* (17)	School	Rating scale	Teacher	8	4–12	Not specified	8258	7.3

Table 4 Studies assessing prevalence of ADHD symptoms as defined by DSM-III-R in non-US children and adolescents

Country	Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
Canada	Breton *et al* (24)	Representative sample of children aged 6–14 years from throughout Quebec	Interview	Parent, teacher, subject (6–11 years)	10	6–14	Not specified	2400	8.9 (teacher) 5.0 (parent) 3.3 (subject)
Finland	Puura *et al* (62)	Representative sample of children born 1981–9 and living in three areas in Southern Finland	Rating scale, Interview	Parent, subject	8.5	8–9	50	3397	6.6 (parent) 0.6 (subject)
Germany	Baumgaertel *et al* (16)	School	Rating scale	Teacher	8.5	5–12	Not specified	1077	10.9
Israel	Zohar *et al* (45)	Consecutive inductees into the Israeli army	Interview	Subject	–	16-17	67	562	3.9
Italy	Gallucci *et al* (63)	School	Rating scale	Teacher	9	8–10	50	232	3.9
Japan	Kanbayashi *et al* (64)	School	Rating scale	Parent	8	4–12	48	1022	7.7
The Netherlands	Verhulst *et al* (46)	Representative national sample of children aged 13–18 years	Interview (parent, subject) Rating scale (parent, subject, teacher)	Teacher, parent, subject	15.5	13–18	Not specified	780	1.8 (parent) 1.3 (subject)
New Zealand	Fergusson *et al* (47)	Birth cohort of children born in Christchurch urban region in 1977	Interview	Parent, subject	15	–	Not specified	986	3.0 (parent) 2.8 (subject)
Spain	Gomez-Beneyto *et al* (23)	Representative sample of children in Valencia of the defined ages	Interview	Parent, teacher	–	8 11 15	50 49 51	326 385 416	14.4 5.3 3.0
Sweden	Landgren *et al* (65)	Children born in 1986–7 and living in Mariestad, a rural area of southern Sweden when aged 6 years	Rating scale (parent, teacher) Interview (parent)	Teacher, parent	6.5	6–7	Not specified	589	4.0
Taiwan	Wang *et al* (66)	School	Rating scale	Teacher	9.5	7–12	52	4290	9.9

years, comparable to that of the six US studies analyzed. Prevalence rates for these eight studies ranged between 3.9% and 14.4%.

DSM-IV studies

A total of 19 studies have now been published which used the DSM-IV diagnostic criteria; this included eight studies of US populations and 11 from non-US populations. Two of these studies also present prevalence data according to DSM-III-R criteria (16,17) and DSM-III criteria (16).

Of the eight US studies, one was in adults (48) and one used more lenient criteria in order to select sufficient girls for further study (49) and hence will not be discussed further. Six studies reported the prevalence of ADHD symptoms (i.e. fulfilment of criteria A only) and gave rates of 9.5-16.1% (Table 5). When only the four studies of children with mean ages of approximately 8-10 years are considered, this gives a prevalence range of 11.4-16.1%. Most of these studies diagnosed ADHD on the basis of either teacher or parent reports; only Rowland et al (50) employed teacher and parent reports of symptoms. Importantly, the data reported by Rowland et al are within the range reported for studies using a single informant and thus suggest that data from single-informant studies may be valid for comparing prevalence rates. Wolraich et al (18) reported the prevalence of ADHD both according to symptoms alone (16.1%) and when functional impairment was also required (6.8%). This indicates that estimates of ADHD prevalence based on symptom assessment alone are likely to be overestimates. However, such data may be useful to assess the relative prevalence of ADHD symptoms in different countries and cultures with the caveat that this should not be equated with the actual prevalence of ADHD.

Of the 11 studies of non-US populations, all except one (51) used teacher and/or parent assessments of ADHD symptoms. Of these 10 studies, nine were in children with a mean age between 7 and 11 years. These nine studies reported rates of ADHD symptoms ranging from 2.4 to 19.8% (Table 6). Of these studies, five reported rates in the narrower range of 16.0-19.8%, which is at the high end of the range reported for the six US studies which spanned a similar age range. The studies that reported lower rates (2.4-7.5%) were the two studies of Australian populations, the only study of an Icelandic population, and the Swedish study. The low rates in the Australian, Icelandic and Swedish studies may reflect cultural differences in these populations. However, it is interesting to note that in one of the Australian studies (52), which reported the lowest prevalence rate (2.4%) when using combined teacher and parent assessments, the prevalence rates based on parent assessments alone (9.9%) and teacher assessments alone (8.8%) were similar to those reported in the US studies. Two studies additionally reported prevalence rates based on functional impairment and these rates were lower than those for symptoms alone - symptom prevalence, 7.5%; impairment prevalence, 6.8% (19); symptom prevalence, 15.8%; impairment prevalence, 0.2% (53) - in agreement with the findings of Wolraich et al (18).

Comparison of prevalence rates

Table 7 shows the range of prevalence rates for US and non-US populations for the three DSM diagnostic criteria when outlying values have been excluded. Comparison of the prevalence range for the US studies shows that the highest prevalence is reported when using DSM-IV criteria, as has previously been shown by Wolraich et al (17) and Baumgaertel et al (16). The non-US studies also showed a higher prevalence of ADHD when using DSM-IV diagnoses. As Table 7 shows, the range of prevalence

Table 5 Studies assessing prevalence of ADHD symptoms as defined by DSM-IV in US children and adolescents

Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
Gimpel and Kuhn (67)	Sample of children enrolled in daycare centers in Utah and Nebraska	Rating scale	Parent	4	2–6	54	253	9.5
Hudziak *et al* (68)	Female twins in community	Interview	Parent	-	13.5-19.5	0	1269 pairs	9.9
Nolan *et al* (69)	School	Rating scale	Teacher	10.5	3–18	54	3006	15.8
Rowland *et al* (50)	School	Rating scale (teacher) Interview (parent)	Teacher and parent	-	8–12	Not specified	362	16
Wolraich *et al* (17)	School	Rating scale	Teacher	8	4–12	Not specified	8258	11.4
Wolraich *et al* (18)	School	Rating scale	Teacher	-	4–12	Not specified	4323	16.1 (symptoms) 6.8 (functional impairment)

Table 6 Studies assessing prevalence of ADHD symptoms as defined by DSM-IV in non-US children and adolescents

Country	Author(s)	Sample	Assessment method	Informant	Age mean (years)	Age range (years)	Males in sample (%)	Sample size	Prevalence (%)
Australia	Gomez *et al* (52)	School	Rating scale	Parent, teacher	8	5–11	47.4	1275	2.4 (parent/teacher) 9.9 (parent) 8.8 (teacher)
	Graetz *et al* (19)	Representative national sample of children aged 6–17 years	Interview and rating scale	Parents		6–17	Not specified	3597	7.5 (symptoms) 6.8 (functional impairment)
Brazil	Guardiola *et al* (70)	School	Interview	Investigator	7.5	7–8.8	49.4	484	18
	Rohde *et al* (71)	School	Rating scale	Subject	13	-	49	1022	5.8
Colombia	Pineda *et al* (14)	School	Rating scale	Parent	9.1	4–17	50	540	16
	Pineda *et al* (72)	School	Rating scale	Parent, teacher	10.5	4–17	54	341	17.1
Germany	Baumgaertel *et al* (16)	School	Rating scale	Teacher	8.5	5–12	Not specified	1077	17.8
	Essau *et al* (53)	Community	Rating scale and interview	Parent, subject	14.5	12–17	41	1009	15.8 (symptoms) 0.2 (functional impairment)
Iceland	Magnusson *et al* (13)	School	Rating scales	Parent, teacher	7	6–8	47	429	5.7 (teacher) 4.7 (parent)
Sweden	Kadesjo and Gillberg (44)	School	Interview (teacher, parent) Rating scale (teacher)	Parent, teacher	7	6.5–7.5	Not specified	409	3.7
Ukraine (and USA)	Gadow *et al* (15)	Sample of former refugees from Chernobyl living in Kyiv in 1996	Interview	Parent, teacher	10.8 (Ukraine) 10.9 (USA)	10–12 (Ukraine) 9–12.9 (USA)	48.3 (Ukraine) 51.4 (USA)	600 (Ukraine) 443 (USA)	19.8 (Ukraine) 9.7 (USA)

Table 7 Prevalence ranges for ADHD/ADD-H according to DSM diagnostic criteria for US and non-US populations

	N	Approximate range for mean age (years)	Prevalence range
DSM-III			
US studies	4	9–11	9.1–12 (n = 3)
non-US studies	7	7–11	5.8 –11.2 (n = 6)
DSM-III-R			
US studies	6	8–12	7.1–12.8 (n = 4)
non-US studies	9	6–11	3.9–10.9 (n = 7)
DSM-IV			
US studies	4	8–10	11.4–16.1 (n = 4)
non-US studies	9	7.5–11	16–19.8 (n = 5) (higher prevalence studies) 2.4–7.5 (n = 4) (lower prevalence studies)

reported in the non-US studies is, for each diagnostic system, similar to that reported in the US studies.

Several of the non-US DSM-III-R and DSM-IV studies found fairly low prevalence figures, between 2.4 and 7.5%. The countries included in the low-prevalence group are Sweden (2/2 studies in this population), Italy (1/1 study in this population), Australia (2/2 studies in this population), Iceland (1/1 study in this population), and Spain (1/1 study, but only for 11 years age group). This may reflect a true lower prevalence in these countries but further studies are required to confirm this. These countries are not represented in the studies using DSM-III diagnostic criteria.

DISCUSSION

The results of studies using DSM criteria suggest that the prevalence of ADHD/ADD-H is at least as high in many non-US children as in US children. Certain populations may have a lower prevalence of ADHD symptoms (e.g., Iceland, Australia, Italy, and Sweden), but this cannot be concluded on the basis of the available data. Direct comparisons between different populations are required to truly assess the relative prevalence of ADHD symptoms in different cultures and countries. To date, only one such study has been performed. Gadow et al (15) reported on the prevalence of ADHD symptoms in a sample of 600 Ukrainian children (aged 10-12) and an age-matched sam-

ple of 443 US children. The Ukrainian children were a sample of those living within 30 km of the Chernobyl nuclear power plant who were evacuated to Kyiv and remained living there 10 years later. This study reported a prevalence of ADHD symptoms of 19.8% for Ukrainian children compared with 9.7% for the US sample. It is unclear why the prevalence of ADHD symptoms should be so much higher in the sample of Ukrainian children. It is possible that the higher Ukrainian prevalence reflects the environmental adversity and psychosocial dislocation associated with the Chernobyl disaster, but we can draw no firm conclusions in the absence of an appropriate Ukrainian control group.

While the populations studied in the papers included in this report are not necessarily representative of all child populations worldwide, they are sufficient to demonstrate that ADHD is not purely an American disorder and that the prevalence of this behavioral disorder in many countries is in the same range as that in the USA. Although a number of prevalence studies were not included in this analysis because they employed other diagnostic criteria, such as the ICD-9 and ICD-10 criteria, the populations they studied are for the most part represented in the selection of studies included in this analysis. Thus, the decision to include only studies employing DSM diagnostic criteria was unlikely to make the selected studies unrepresentative of the populations studied to date.

Recognition of ADHD as a disorder affecting a significant percentage of children in many countries has important implications for the psychiatric care of children. Numerous studies have shown that appropriate management can significantly impact on the symptoms of ADHD and thus help children and their families overcome and live with the burden of this disorder (54,55). Management options include: educational strategies which help the child and adolescent achieve their academic potential at school and college; behavioral treatments aimed at teaching the child, their parents and teachers how to modify problem behaviors; and pharmacotherapy which has been shown to be highly effective for the long-term control of core symptoms. However, in the absence of adequate recognition of the disorder by the medical community, the teaching profession and the public in general, children with this behavioral disorder are unlikely to receive the assistance they require to achieve their full potential, at school, at home, and into adulthood.

In conclusion, the data from studies using DSM criteria to assess the prevalence of ADHD in representative child and adolescent populations suggest that there is no convincing difference between the prevalence of this disorder in the USA and most other countries or cultures. It is difficult to make exact comparisons between countries because the estimated prevalence is highly influenced by the means of assessment and the type of sample recruited. However, the range of prevalence rates for DSM symptoms reported in US child populations appears to fall within those reported for non-US child populations (except for those of Iceland, Australia, Italy and Sweden).

One limitation of the literature we reviewed is the reliance of many studies on rating scale measures rather than interviews with patients and parents. Unlike rating scale methods, interview-based procedures come close to reproducing the results one might expect from a clinical evaluation and are better able to incorporate the impairment and pervasiveness criteria of the DSM diagnoses of ADHD. Further interview-based studies assessing the prevalence of ADHD as defined by the DSM-IV criteria, and directly comparing the prevalence in different countries, are required to provide a clearer picture of the burden of ADHD worldwide. We have also relied on the DSM as a method of comparing the cross-cultural prevalence of ADHD. As discussed by Hartman et al (56), it is possible that improved operationalization of symptoms could lead to increased measurement precision and a better assessment of the cross-national validity of diagnostic categories. In addition, this research needs to be followed up into clinical practice, with a better awareness of this disorder and the effective means of alleviating the associated symptoms and its burden on the individual and society as a whole.

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